**Solar Electric Technician (Level 2)**

**Module 6: Testing and commissioning**

**E2: Assignment - Testing and commissioning**

|  |  |
| --- | --- |
| **E2: ASSIGNMENT MEMO** | |
| **Date** | …. |
| **To** | Participants |
| **From** | Trainers |
| **Subject** | Testing and commissioning |
| **What** | Perform testing and commissioning of a three-phase solar photovoltaic (PV) system (Including on-grid inverter, batteries, and water pump) in small groups. |
| **Why** | Trainees will gain hands-on experience in testing and commissioning a complete three-phase solar photovoltaic (PV) system, including an on-grid inverter, batteries, and a water pump. By the end of the session, trainees will be able to inspect the system, perform electrical tests, verify functionality, and commission the system. |
| **How** | 1. Work in group of 2 or 4. 2. Collect all the necessary tools and equipment for the task. 3. Read and carefully follow the instruction for the assigned task and record the results. 4. Study the demo system and perform the checks as outlined in the instructions. 5. Review and discuss the results with the trainer. |
| **Time** | 225’ |

**Perform testing and commissioning of three-phase solar photovoltaic systems.**

**Required tools/equipment and demo three-phase solar PV system**

**Three-phase solar PV system setup:**

* Solar panels
* On-grid inverter (with grid-tied functionality)
* Battery bank (for energy storage)
* Solar charge controller (if needed)
* DC and AC disconnects
* Water pump (for a solar-powered water pumping system)

**Tools and equipment:**

* Multimeter (for voltage, current, and continuity testing)
* Clamp meter (for measuring current in live circuits)
* Battery tester (to check battery bank capacity and performance)
* Torque wrench, wire strippers, crimping tools, screwdrivers
* Personal protective equipment (PPE): gloves, safety goggles, insulated boots
* System wiring schematics and installation manual
* Water source and plumbing setup for water pump testing (optional)
* Notepad and pen for documentation

**Expected outcomes**

* Safety compliance: Trainees consistently follow safety procedures and use PPE correctly.
* System knowledge: Trainees gain a solid understanding of testing and commissioning of a three-phase solar photovoltaic (PV) system.

1. **Safety briefing and system overview (20 minutes)**

**Task 1:** Understand the safety procedures and gain an overview of the system components.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Compliance** |
| Safety first | * Wear all required PPE (gloves, safety goggles, insulated boots). * Follow lockout/tagout procedures and de-energize the system before working on any electrical components. * Handle batteries with care, noting the risk of high voltage on both DC and AC sides. * Be mindful of live connections when working with an on-grid inverter tied to the utility grid. |  |
| System components overview | * Solar panels, on-grid inverter, battery bank, solar charge controller (if included), and water pump. * Review the system wiring diagram to understand connections between the panels, inverter, batteries, and pump. |  |

1. **Wiring integrity inspection (30 minutes)**

**Task 2:** Inspect the system’s wiring for correctness, damage, and safety and record any issues or observations, such as loose wires, poor cable management, or missing labels in the table below.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Documentation of results/observations/remarks** |
| Visual inspection | * Check that wires are properly connected to the solar panels, inverter, charge controller, battery bank, and water pump. * Verify correct cable labelling, color-coding, and routing (no damage, wear, or loose connections). * Inspect grounding for proper attachment and condition. |  |
| Verify connections | * Ensure DC and AC disconnects are properly wired and functional. * Check all connections between the inverter, battery bank, and grid connection (for the on-grid system). |  |

1. **Continuity and grounding tests (25 minutes)**

**Task 3:** Test continuity and verify the grounding system’s functionality. Document any issues where continuity is not confirmed or there are signs of improper grounding.

|  |  |  |
| --- | --- | --- |
| **Test** | **Instructions** | **Documentation of results/observations/remarks** |
| Continuity test | * Use a multimeter to perform continuity tests on the following: * DC wiring (solar panels to inverter, inverter to charge controller/batteries). * AC wiring (inverter to grid connection, inverter to load, water pump). * Battery connections (positive to negative leads). * Verify grounding continuity between all key system components and the ground point * Check that wires are properly |  |

1. **Testing the solar panels and system performance (25 minutes)**

**Task 4:** Test the solar panels and verify their performance using advanced tools and document the performance and note any abnormalities, such as reduced output due to shading or dirt.

|  |  |  |
| --- | --- | --- |
| **Test** | **Instructions** | **Documentation of results/observations/remarks** |
| Open-circuit voltage (Voc) and Short-circuit current (Isc) | * Use a multimeter to measure the open-circuit voltage and short-circuit current of each solar panel string. * Compare the measured values to the manufacturer’s specifications. |  |

1. **Testing the battery bank (25 minutes)**

**Task 5:** Test the functionality and capacity of the battery bank and document any findings regarding the battery’s health, capacity, and charge/discharge performance.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Documentation of results/observations/remarks** |
| Battery Voltage and State of Charge | * Use a multimeter or battery tester to measure the battery bank’s voltage. * Check the state of charge (SOC) to ensure that the batteries are charged to the expected level. |  |
| Discharge and Charge Testing | * Test the battery under load by discharging it and monitoring the voltage drop. * Check that the battery bank is charging properly when connected to the solar panels via the charge controller. |  |

1. **On-grid inverter testing (25 minutes)**

**Task 6:** Verify the inverter’s performance in converting DC to AC and connecting to the grid and record all test results, particularly any issues with synchronization, phase imbalance, or incorrect voltage outputs.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Documentation of results/observations/remarks** |
| DC input testing | * Measure the DC input voltage and current from the solar panels to the inverter. * Ensure the input matches the system specifications (typically 400-600V DC for a three-phase system). |  |
| AC output testing | * Use a multimeter to measure the AC output voltage (usually 230V/400V) on all three phases. * Test the phase balance to ensure even current distribution across all phases. * Verify the inverter’s efficiency by checking the power output and comparing it to the DC input. |  |
| Grid connection check | * Confirm that the inverter synchronizes with the grid (check grid voltage and frequency). * Test the anti-islanding protection by simulating a grid outage (disconnect the inverter from the grid and check if it shuts down). |  |

1. **Testing the water pump (30 minutes)**

**Task 7:** Ensure the water pump is functioning correctly when powered by the solar PV system and record the pump’s performance and note any operational issues in the table below.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Documentation of results/observations/remarks** |
| Check electrical connections | * Verify the proper wiring of the water pump to the AC side of the inverter. * Use a multimeter to measure the voltage supplied to the water pump. |  |
| Pump operation | * Turn on the pump and check if it operates smoothly. * Monitor the current draw with a clamp meter to ensure the pump is not overloaded. |  |
| Flow rate testing (optional) | * If a water source and plumbing setup are available, test the pump’s flow rate and compare it with the manufacturer’s specifications. |  |

1. **System commissioning and final testing (30 minutes)**

**Task 8:** Perform final tests and prepare the system for commissioning.

|  |  |  |
| --- | --- | --- |
| **Test/Inspection** | **Instructions** | **Documentation of results/observations/remarks** |
| Full system functionality | * Ensure all components (solar panels, inverter, batteries, and pump) are functioning together. * Test the system under load and monitor the performance of each part |  |
| Check safety features | * Verify the functionality of all safety features, including overvoltage protection, anti-islanding protection, and battery protection |  |
| Final review | * Perform a final walkthrough, checking all connections, test results, and component functionality. * Complete a commissioning report with all test results and observations. * Note any final issues that need to be addressed |  |

1. **Review and debrief (15 minutes)**

**Task 9:** Discuss the results and lessons learned during the exercise.

**Group discussion:**

* Share your test results, observations, and any problems encountered during the testing process.
* Review common issues in solar PV systems and troubleshooting methods.

**Debrief with trainer:**

* The trainer will provide feedback on your performance, highlighting areas where more attention is needed and discussing best practices.